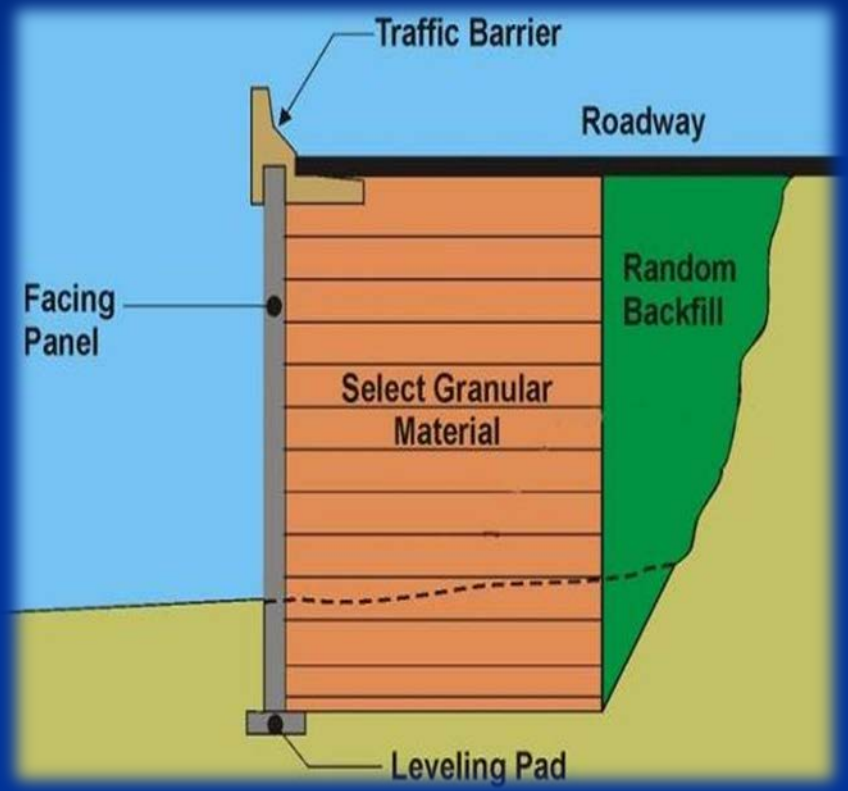
Construction Quality Assurance for MSE Walls

By Alex Abraham, P.E.

Typical section & components of MSE structures

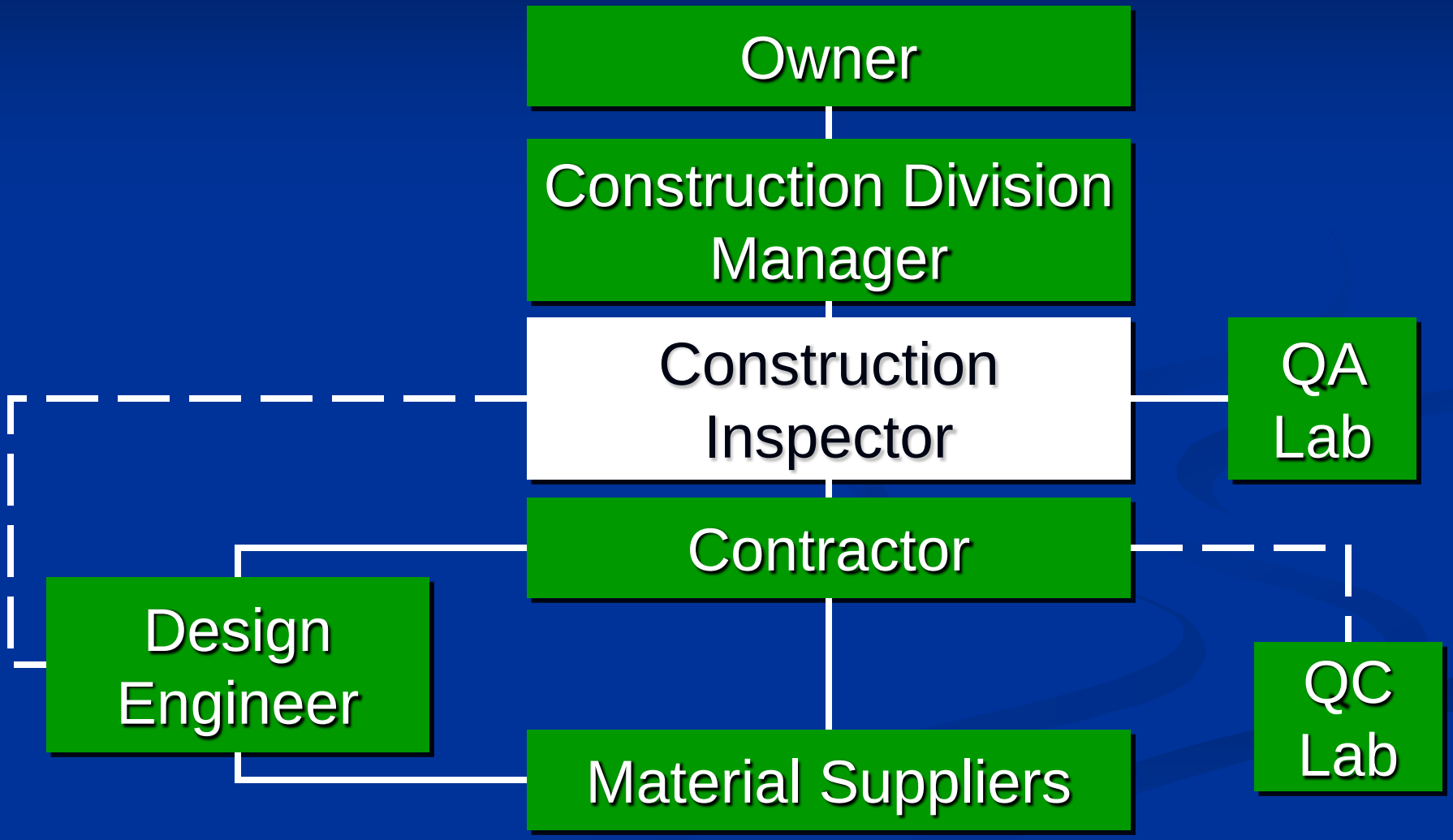


Supplier Design

- Formal Policy
- System Approval
- Design Manual, Details
- Specifications
- Bid Documents
- Supplier Design
- Review

Bid → Design → Build

Organization Chart
Supplier Design



Inspector's Responsibility

To be thoroughly familiar with

- Plans and Specifications
- Site Conditions
- Construction Materials
- Construction Sequence

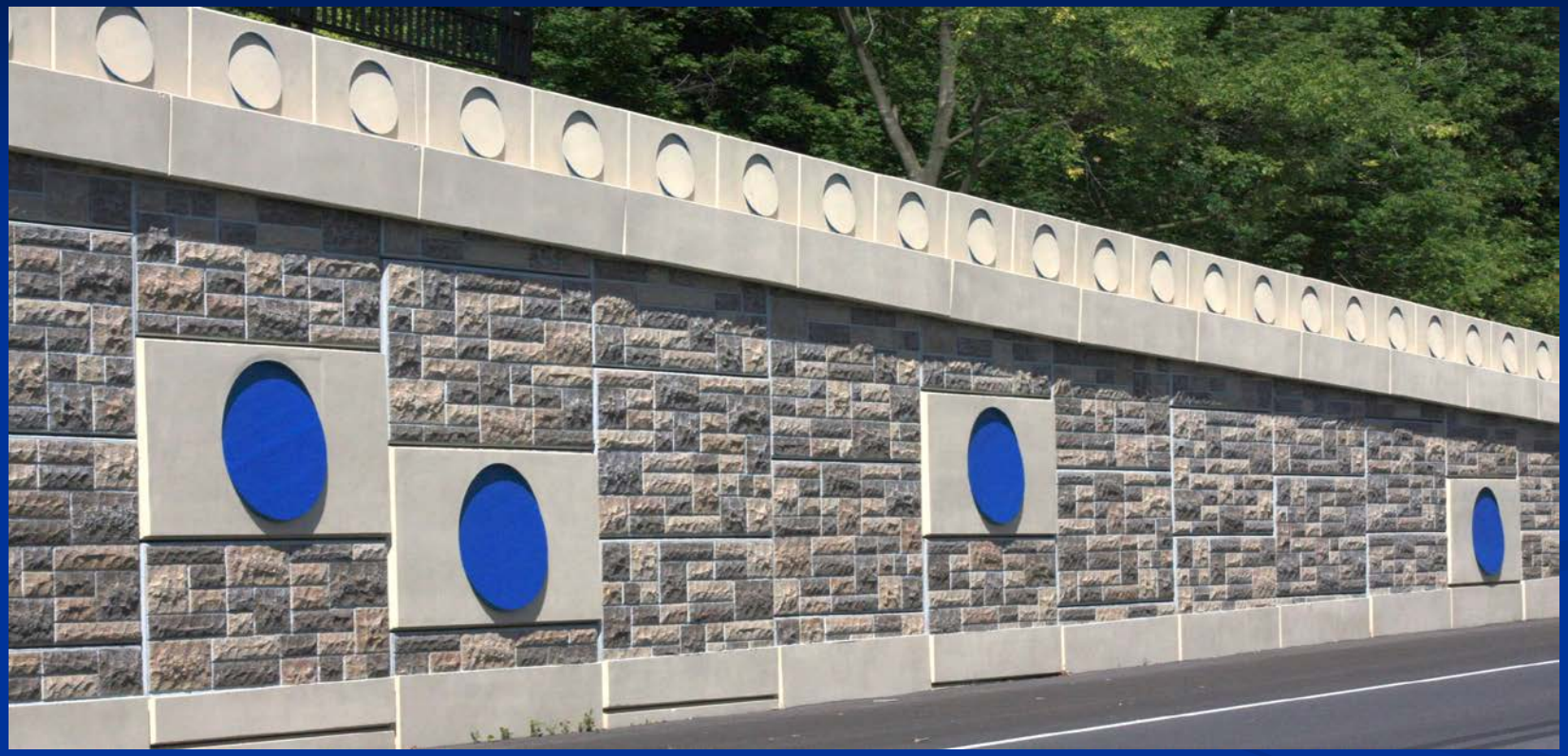
Inspector's Tools

- Design Drawings
- Shop Drawings
- Specs
- Health and Safety Requirements
- Field testing equipment
- Trained Staff
- **CQA Plan**
- **Inspector's Handbook**

Foundation Preparation

Leveling Pads

Facing Panels

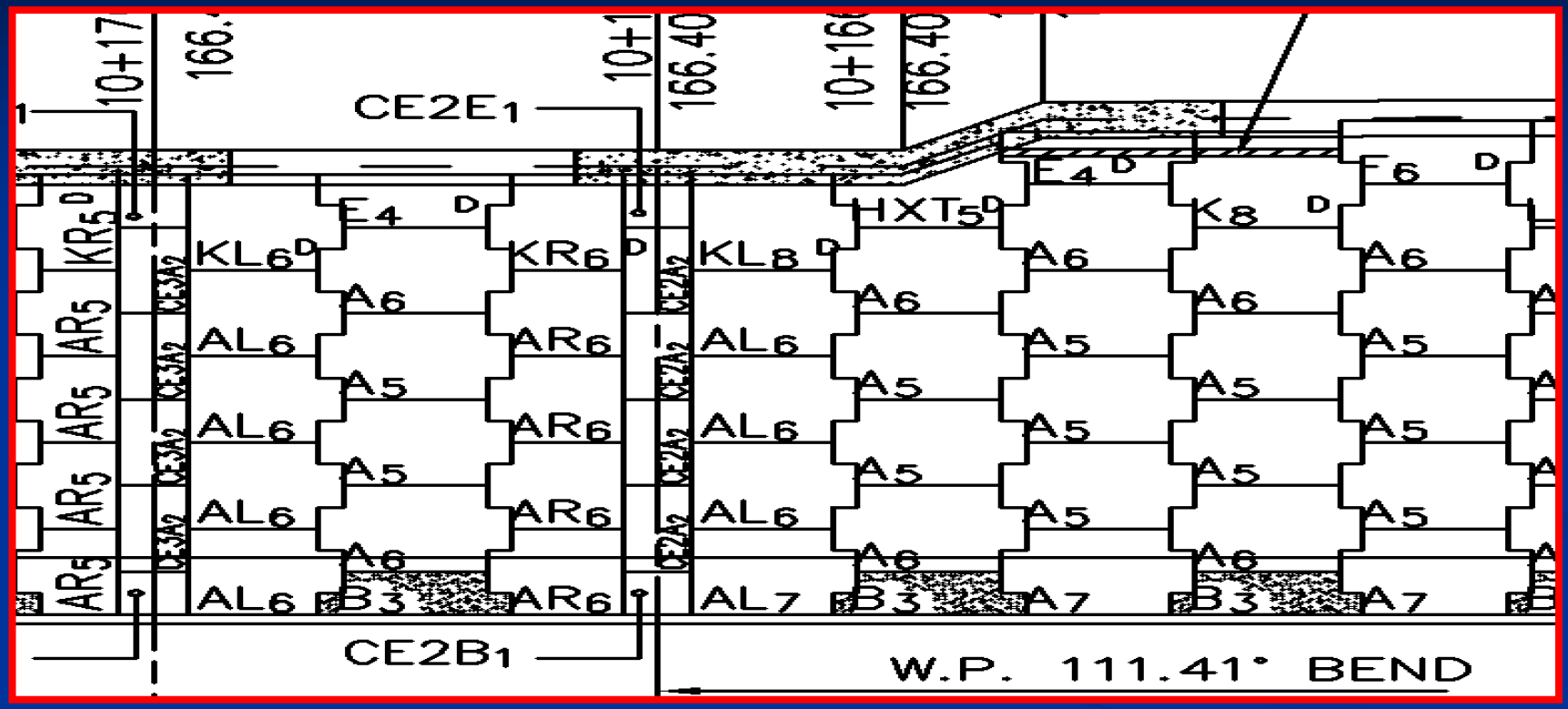


Plant Certification
Liner Fabrication Drawings
Test Panels for Liner and Stain

Panel Storage

Protect Connection Device
Protect Panel Face
Protect Damage to Panels - Cracks, Chipped Corners

Precast Concrete Panels



Certifications

Inspect before the panel is placed on the wall.

Place the correct panel at the right location.

Facing Assembly

Plumb, vertical tolerance, and horizontal alignment tolerance = ¾” over 10’

Allowable offset in panel joint = ¾”

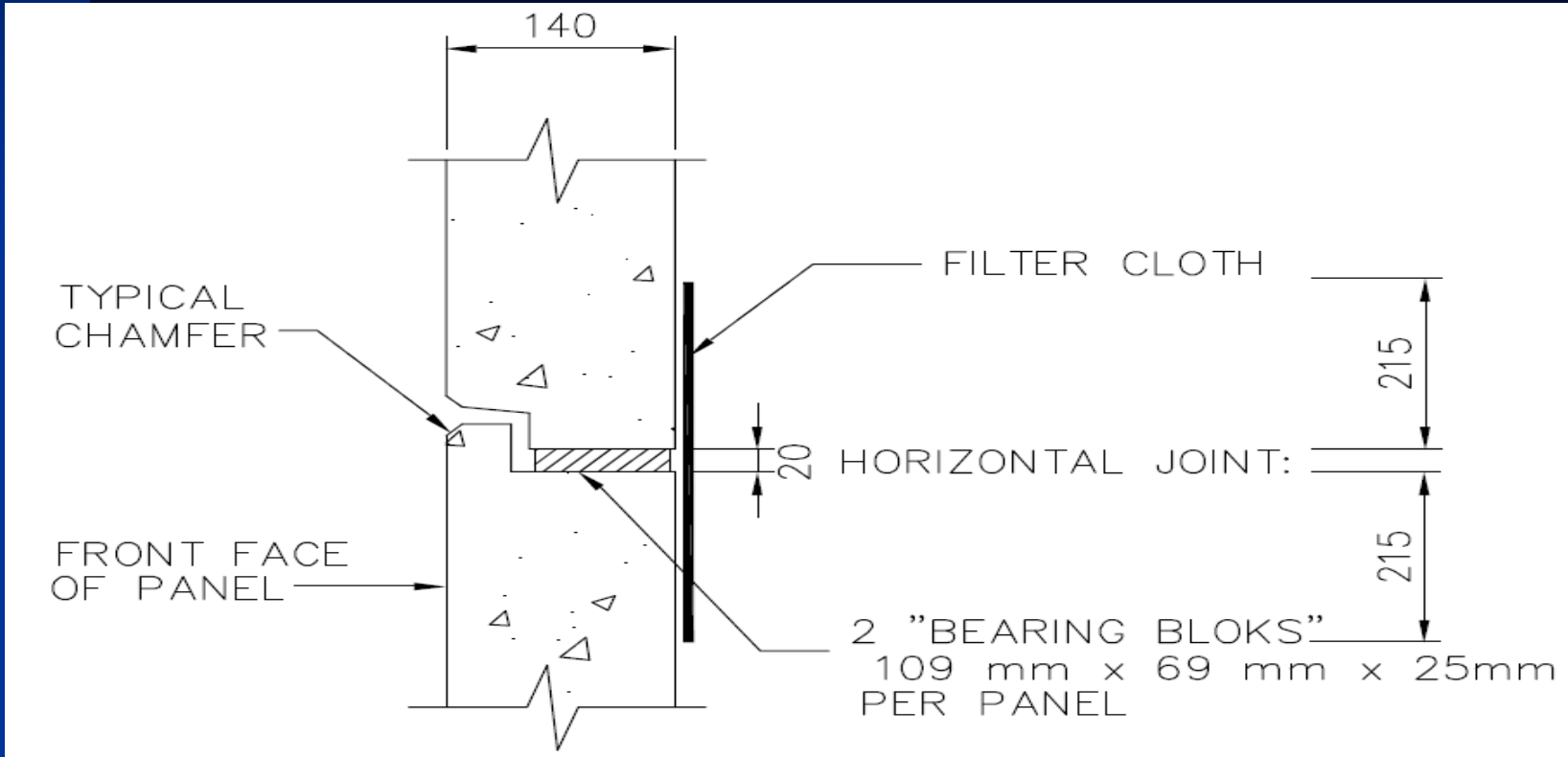
The overall plumb from top to bottom = 0.05 in./ft.

Provide Fall Protection as Required

Filter Fabric

Specifications for filter cloth Placement

Precast Concrete Panels

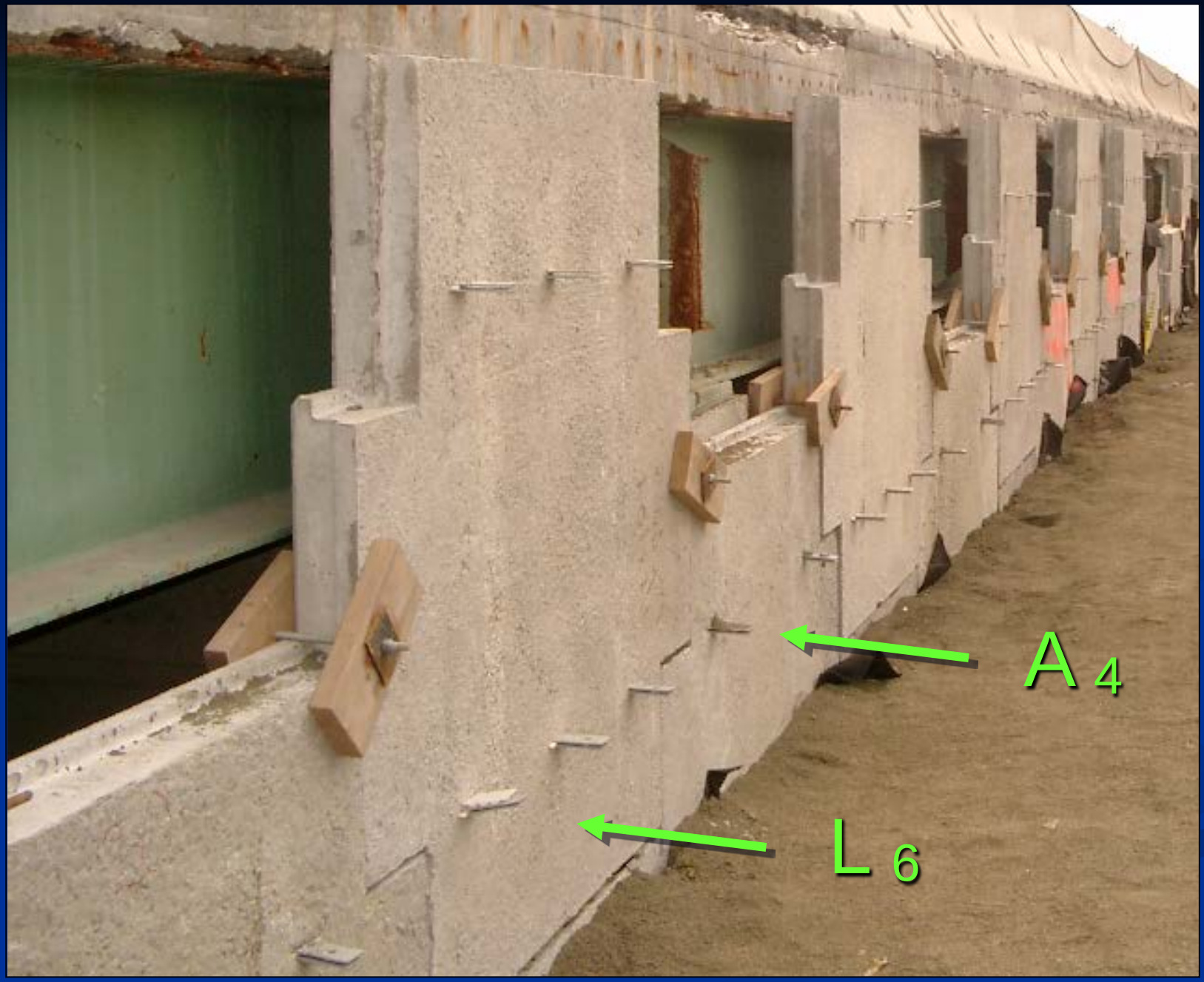


Specifications for filter cloth
Exposure to direct sunlight
Placement

Precast Concrete Panels

Strips Stockpiled on site

Reinforcing – Type, Length, Spacing

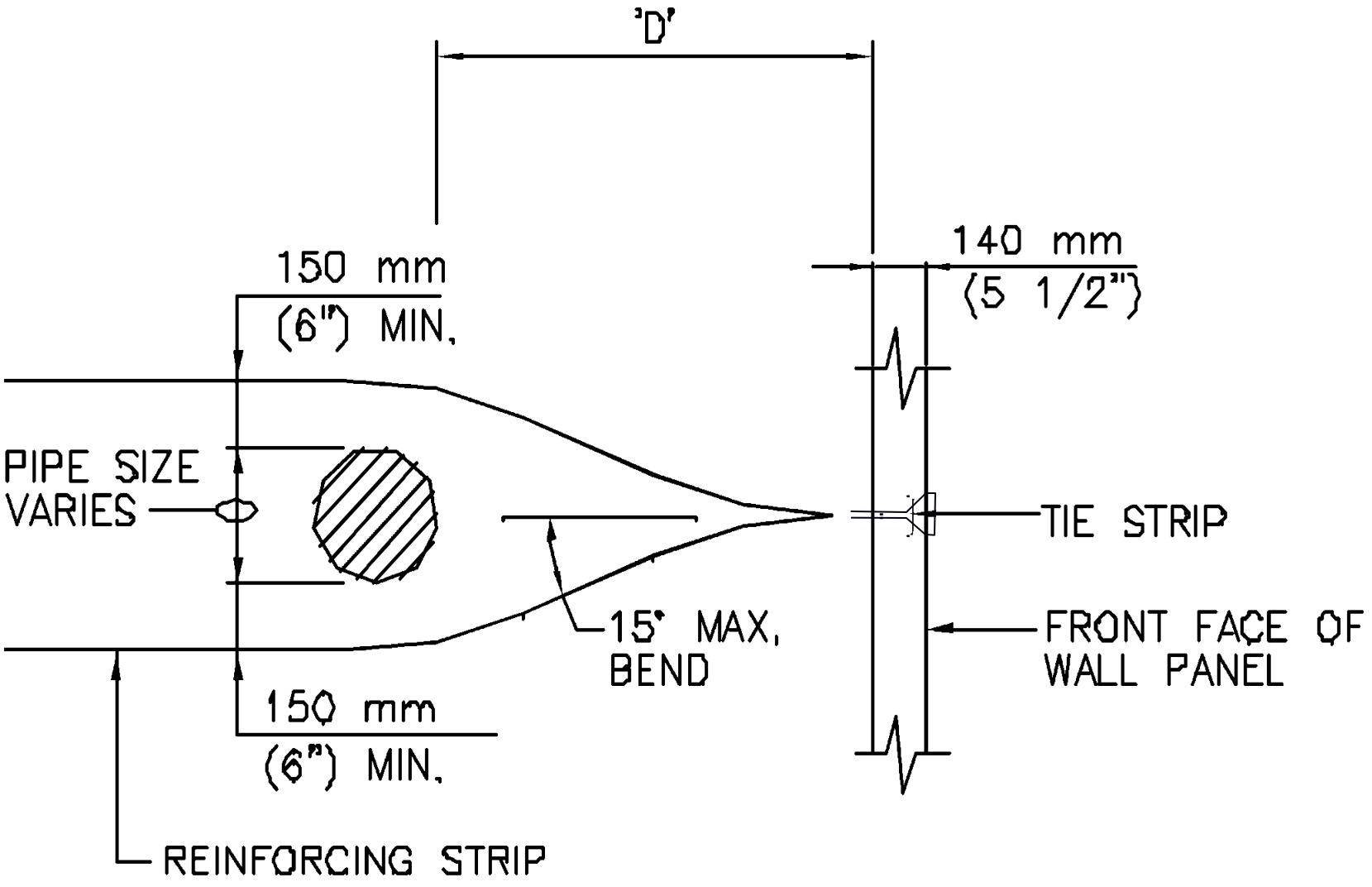

A 4
L 6

Connections

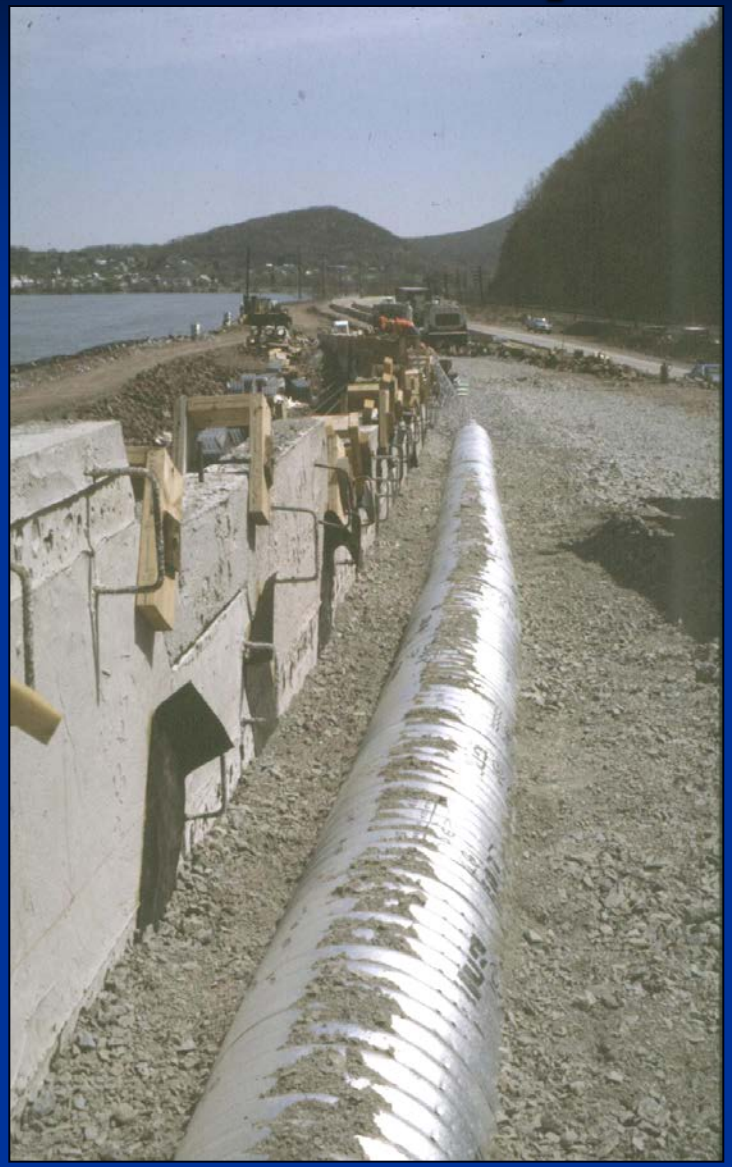
Catch Basin

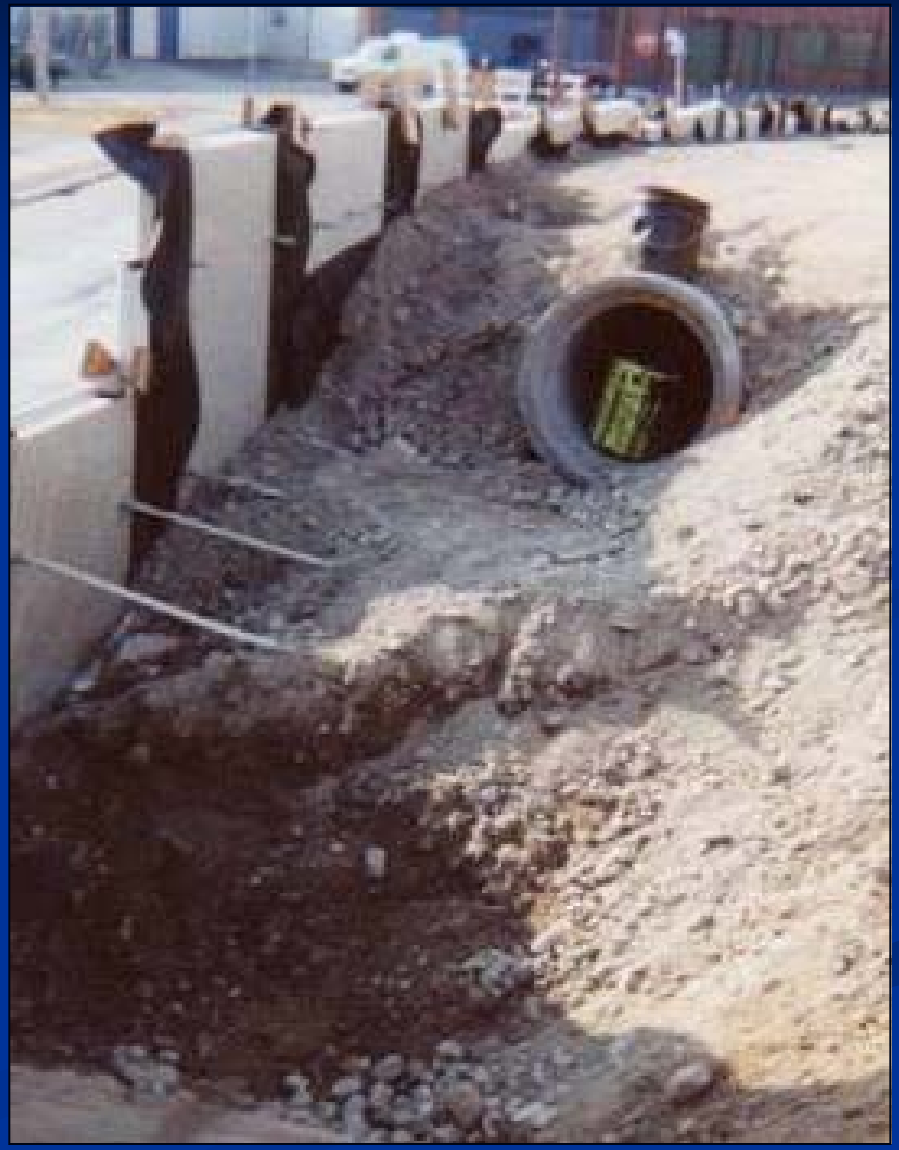
Offset Reinforcements Using Strongbacks **at Large Obstructions**

Parallel Pipes

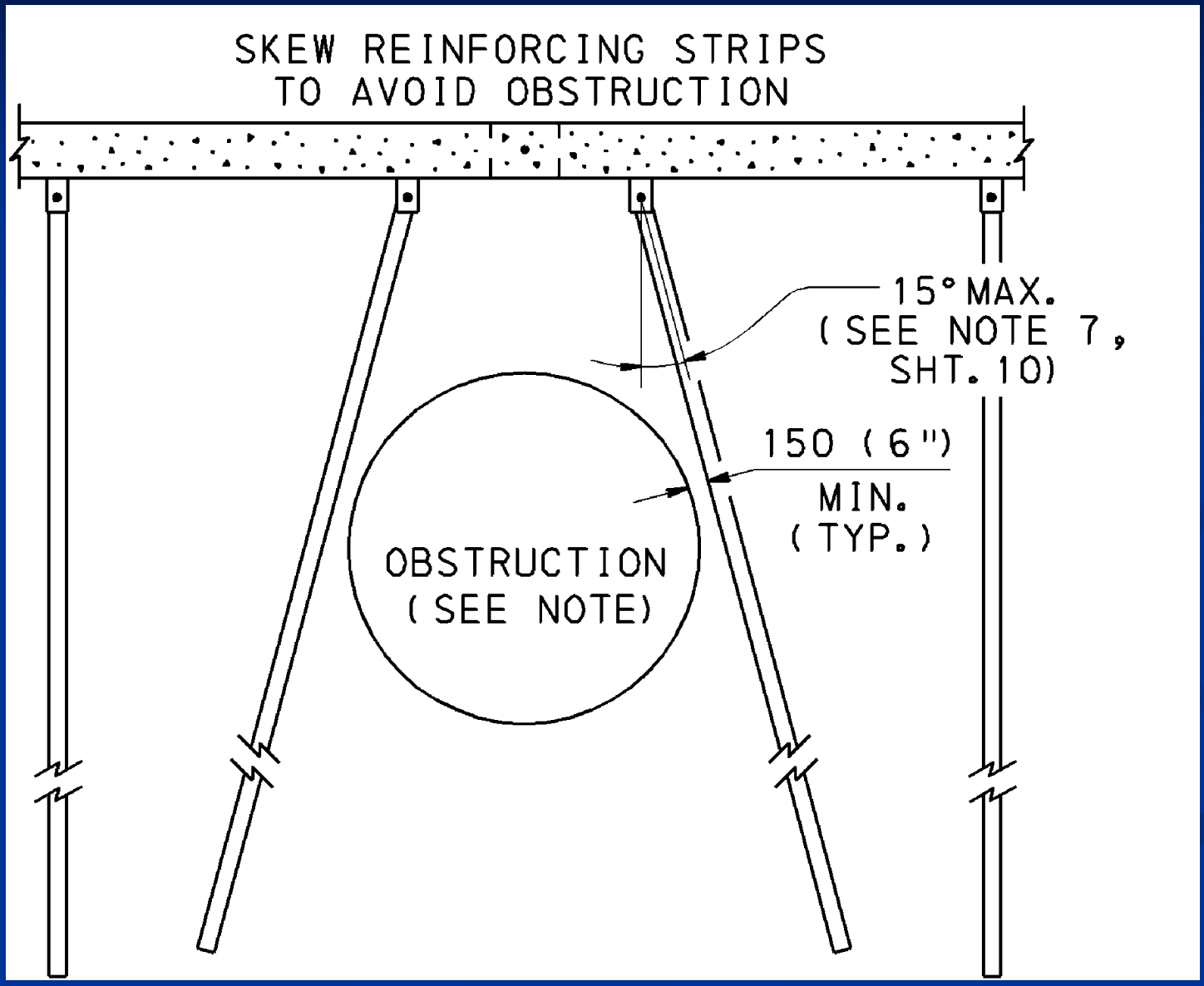


Parallel Pipes





Reinforcement Strip Skew



Accommodating Deep Foundations

Existing Drainage Structures

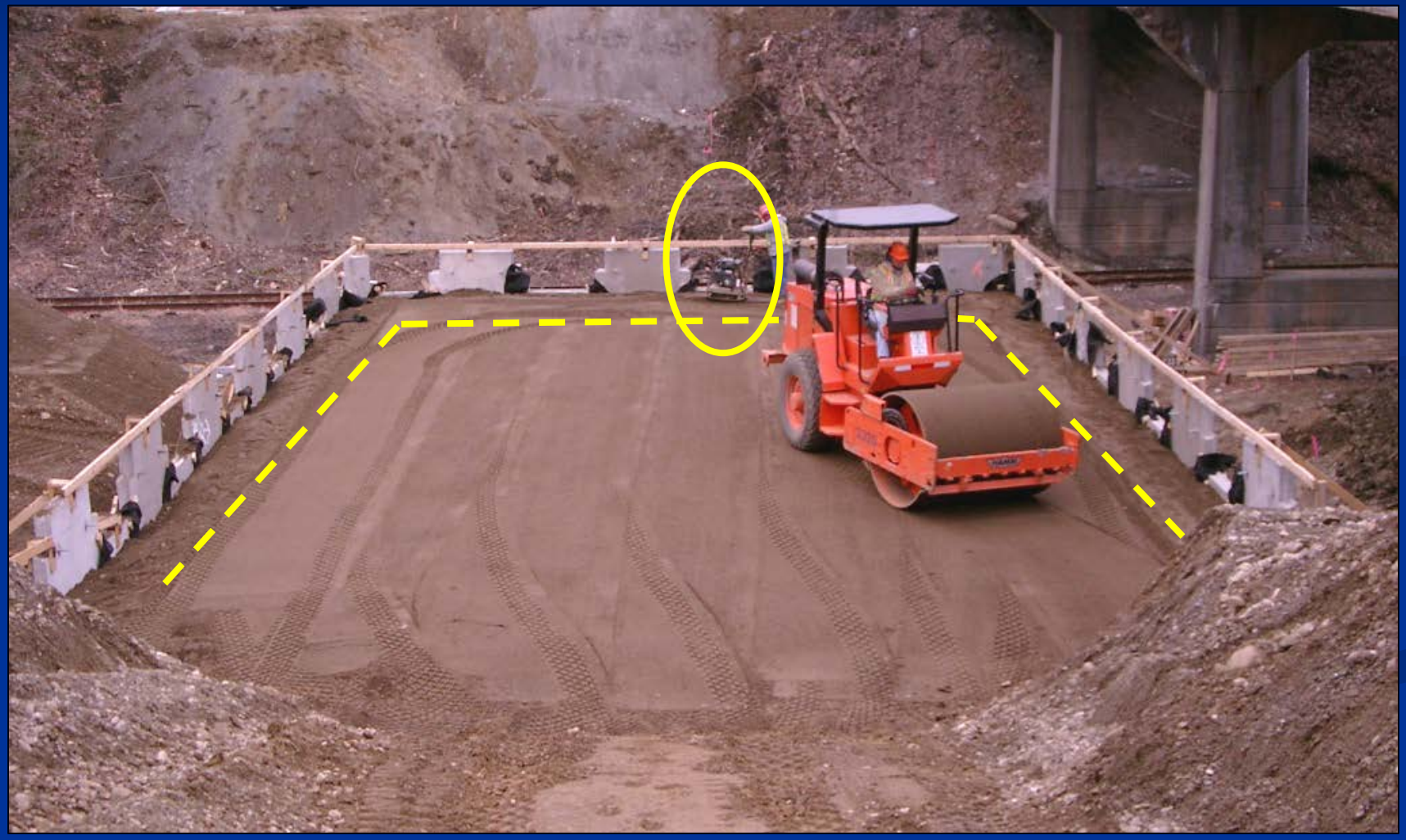
Drainage Penetrations

Select Granular Fill

Structure Backfill, Type 3 (excludes No. 30)

- Approved Source
- Approved Testing Lab
- Laboratory Testing:
  - Gradation
  - Unit Weight (Compaction Control)
  - Friction Angle
  - Organic Content
  - Permeability
  - Resistivity and pH

Compact Backfill (only walk-behind compactor close to wall)



Select Granular Fill
Structure Backfill, Type 3 (excludes No. 30)

- Field Testing for No. 4 size:
  - Criteria – 95%
  - Tests Defined - Section 203.24(b) - Nuclear Density, Sand Cone and One Point Proctor
  - Moisture Content

Select Granular Fill

Structure Backfill, Type 3 (excludes No. 30)

- Field Testing for all sizes other than No. 4 size:
  - No density tests
  - 4 passes with a vibratory roller and 1 pass with the same roller in the static mode.

B-Borrow
(Triangular Wedge of Fill Behind Select Fill)

- Source approved by tests
- Testing:
  - Gradation (no more than 10% passing No. 200 sieve)
  - Suitably graded
  - Frequency of testing (1 per 2,000 t or two per contract)

Fill in front of the wall

- Backfilled as soon as practically possible
- A strong rainstorm could cause heavy flow along the wall. This could cause soil erosion and undermining of the leveling pad and wall.

Drainage

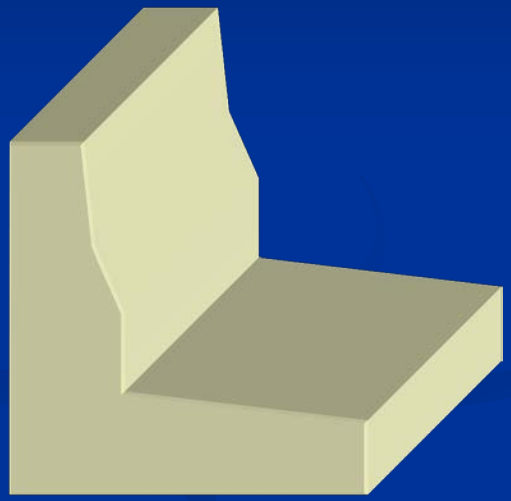
Section 718.03 for underdrains
Location as per plans

Walls subject to Flooding

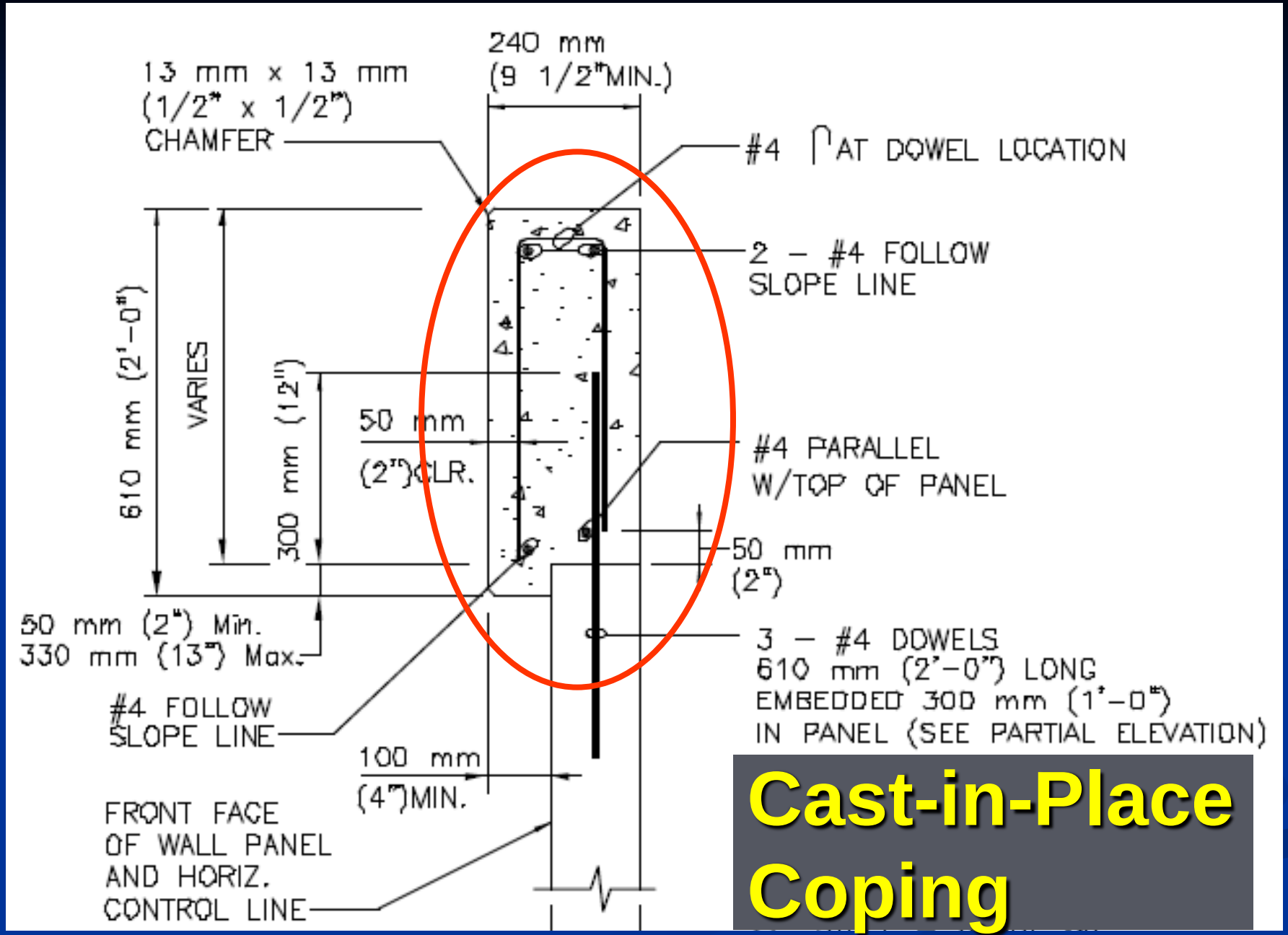
Select Backfill - limited to No. 8 stone

Ancillary Items

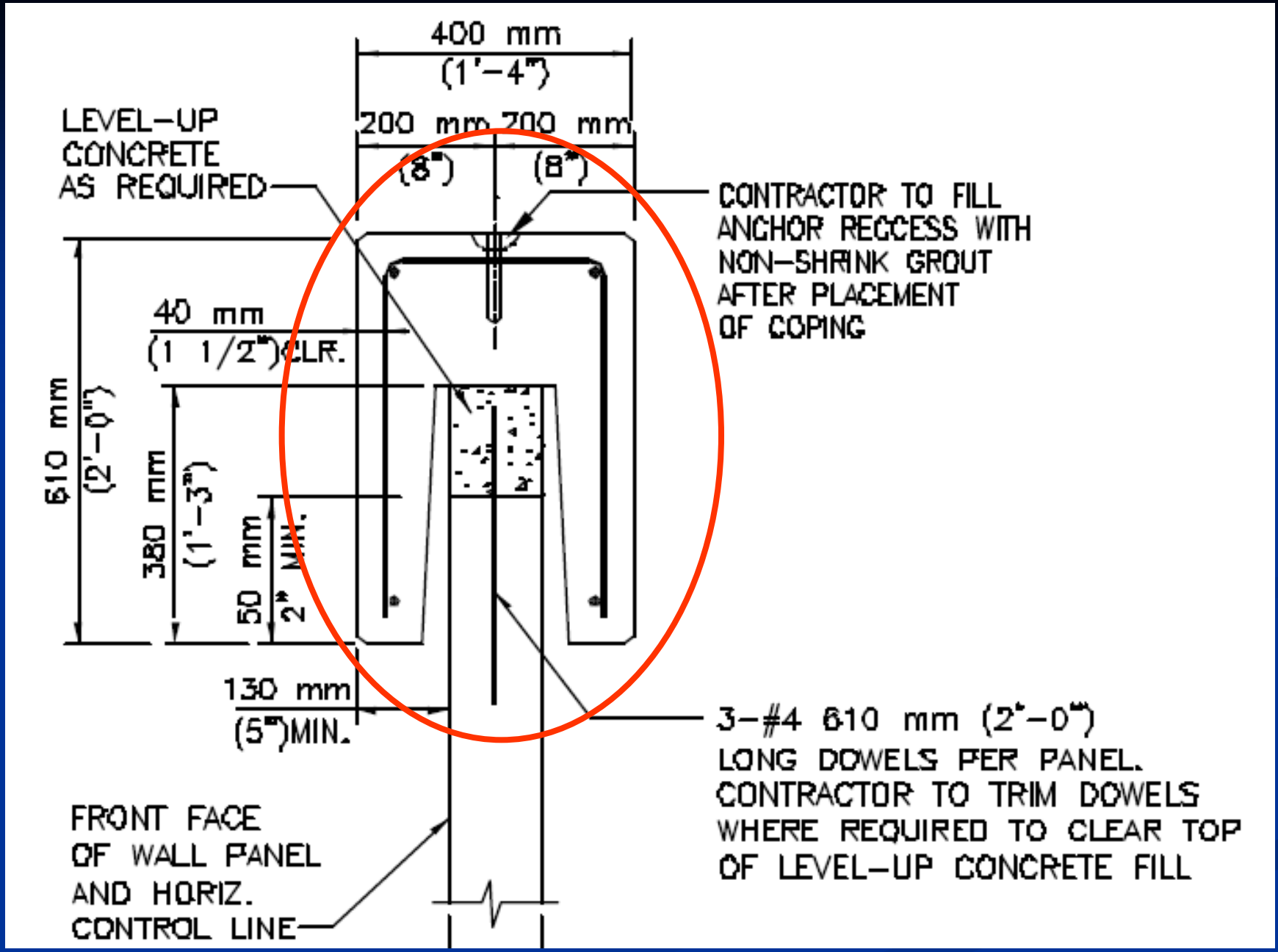
- Barriers
  - Cast-in-place barrier
  - Guard rail
- Coping
  - Precast coping
  - Cast-in-place coping
- Abutments



Precast Concrete Panels



Cast-in-Place Coping

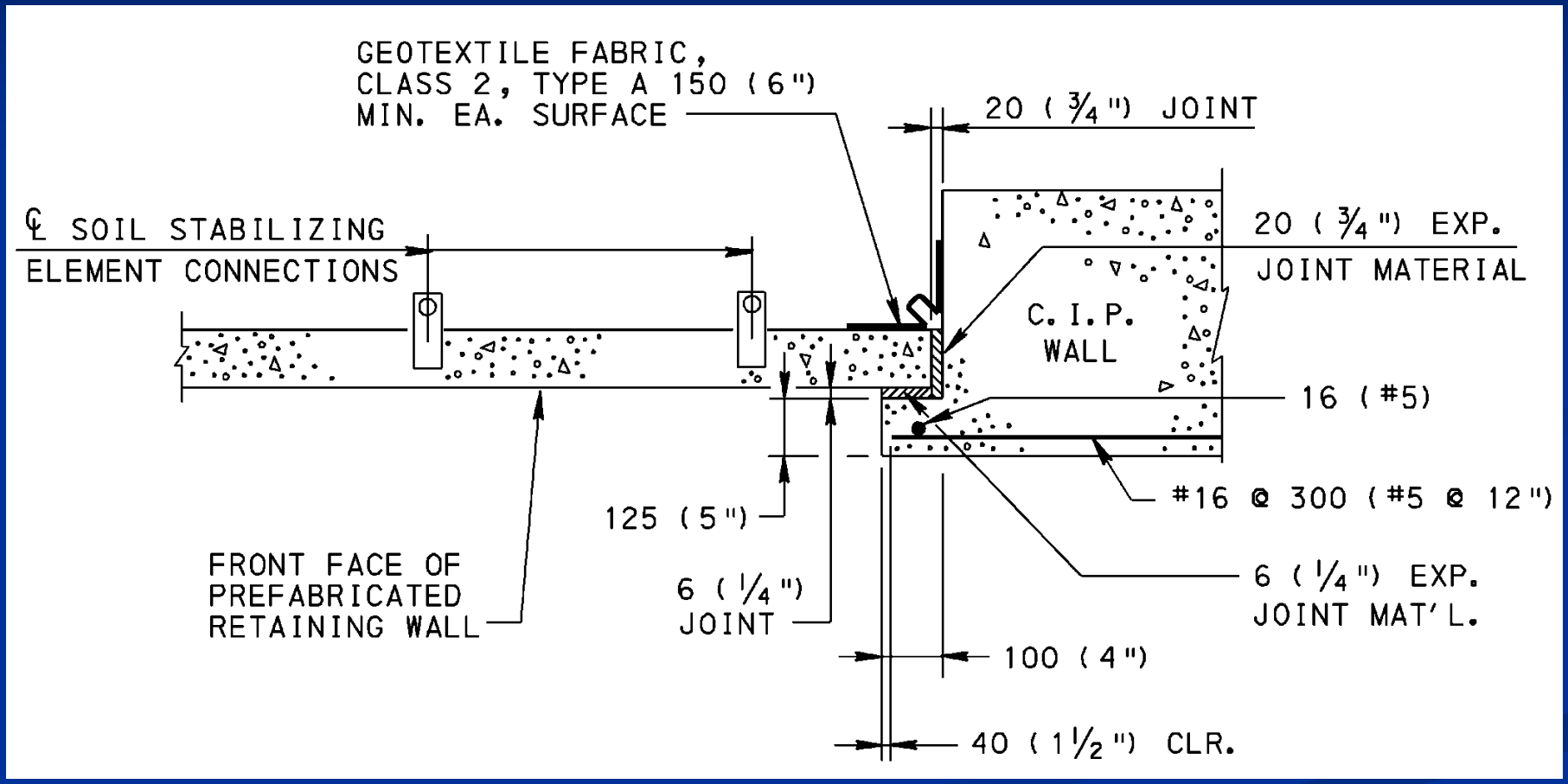


Precast Coping

Skew Top Level of Reinforcements To Clear Guide Rail Post Locations

Guard rails

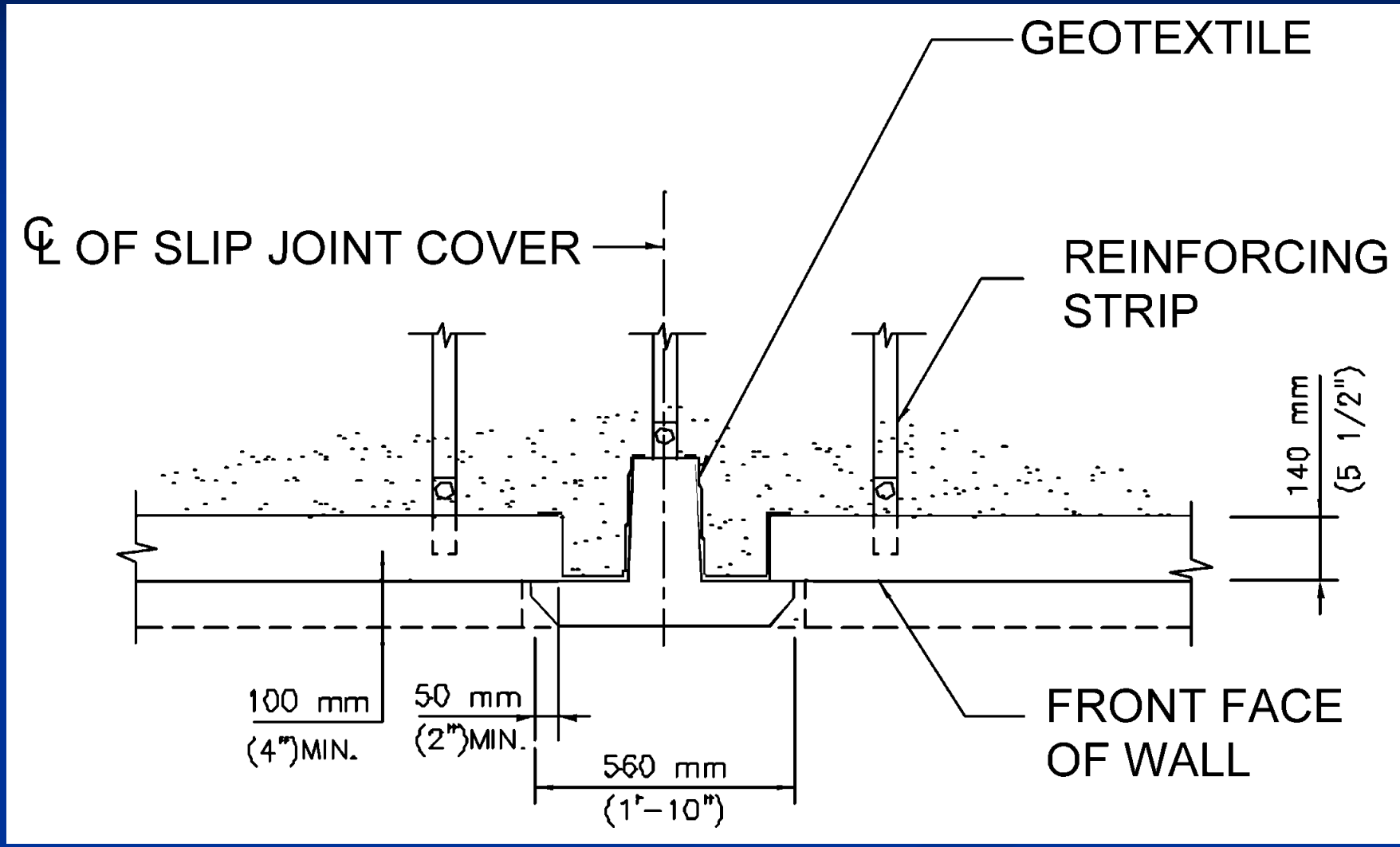
Interface at CIP



Interface at CIP

Slip Joints

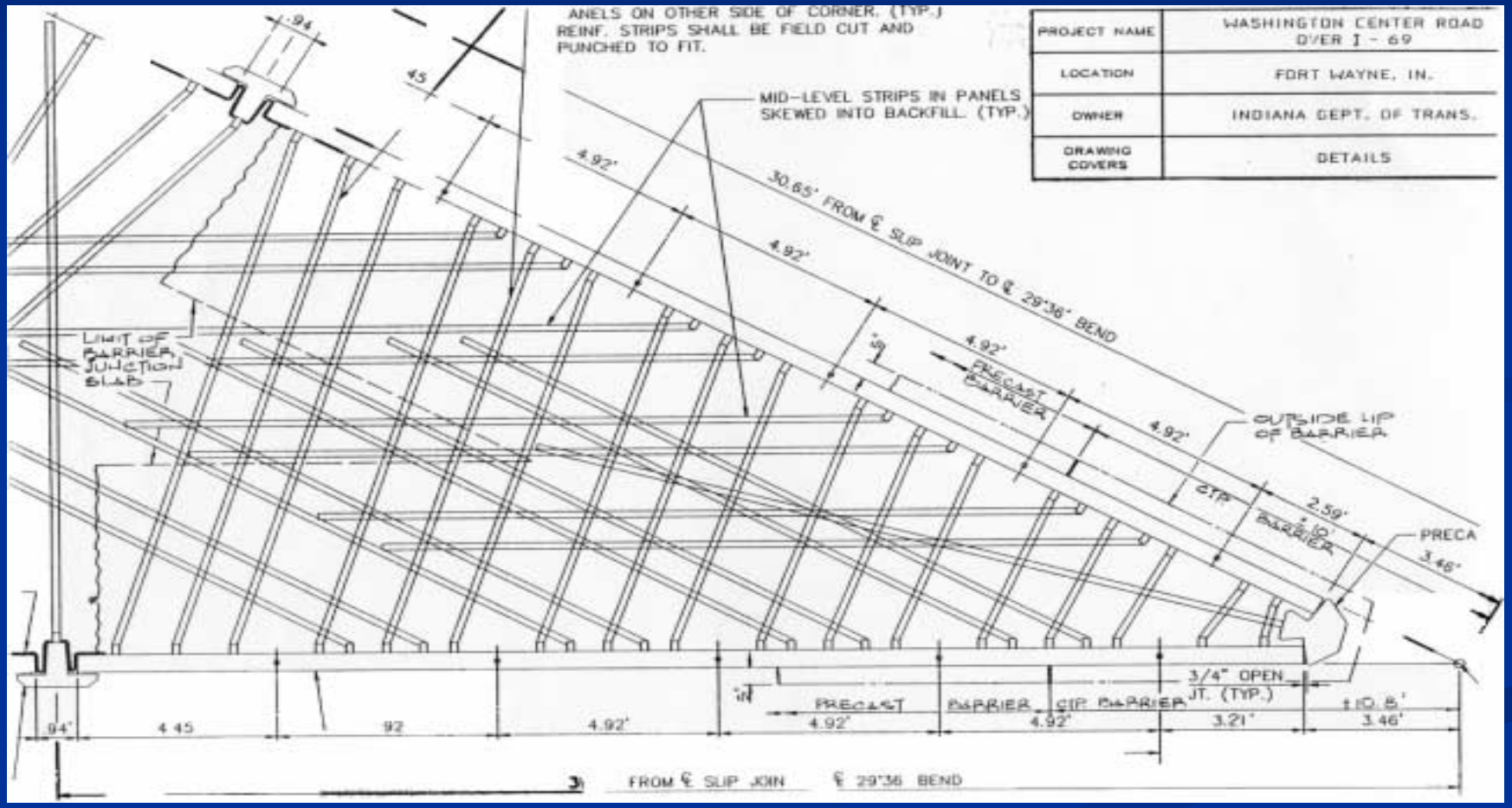
Slip Joint


GEOTEXTILE
℄ OF SLIP JOINT COVER
REINFORCING STRIP
140 mm (5 1/2")
100 mm (4")MIN.
50 mm (2")MIN.
560 mm (1'-10")
FRONT FACE OF WALL

Construction Phasing

Acute Corners

Acute Corners



MSE WALL ASSETS SUPPORT OTHER ASSETS

- Highways, ramps, embankments
- Bridge abutments
- Traffic barriers, noise barriers, lighting, signs, signals
- Drainage pipes, culverts (penetrations)
- Planters & plantings

We know how to manage these assets

When Should We Evaluate Retaining Wall Assets?

- During construction (QA/QC)
- Periodic (routine) performance inspections
- Extreme events (seismic, flood, impact)
- Before widening, load changes, rehabilitation
- As part of plan to extend useful life – *as part of asset management*

Core Questions About MSE Walls

What is the current state of my MSE walls ?

- What do I own?
- Where is it?
- What condition is it in?
- What is its remaining useful life?
- What is its remaining economic value?

More Core Questions

- Which assets critical for sustained performance?
  - How do they fail?
  - How can they fail?
  - What is the likelihood of failure?
  - What will it cost to repair?
  - What are the consequences of failure?

Core Questions - Paraphrased

What are my best investment strategies for "***Moving Indiana into a Prosperous New World"*** ?